GEOLOGY OF THE PARK

2

Yellowstone National Park is a unique physical landscape that provides insight into myriad active geological processes. The fact that Yellowstone is an area of active volcanic, seismic, and hydrothermal geological processes is exactly what makes this national park a unique treasure. This area has a history of catastrophic volcanic eruptions and will continue to have earthquakes (some that will likely be damaging), dynamic geothermal processes, and perhaps even eruptions of lava.

Yellowstone National Park was established for its unique array of geological features and processes. In a sense we can be glad they are still active. While those geological processes impart risk, it is also the volcanic and seismic energy that powers the geysers and related hydrothermal features, creates the majestic mountains and canyons, and generates the unique ecosystems that support Yellowstone's diverse wildlife.

Yellowstone's geology has been shaped by a hotspot, volcanoes,glaciers, sedimentation, and erosion. Its geologic significance includes:

- one of the most geologically dynamic areas on earth due to a rare continental hotspot beneath the surface that causes volcanic activity
- one of the largest volcanic eruptions known to have occurred in the world, leaving behind one of the largest known calderas
- more than 10,000 hydrothermal features, including more than 300 geysers
- the largest concentration of geysers in the world—approximately half of the world's total
- most of the undisturbed geyser basins left in the world (Kamchatka Peninsula has the others; the rest have been modified or destroyed by human development)
- one of the few places in the world where active travertine terraces are found, in Mammoth Hot Springs
- site of the world's largest petrified forest, with many upright trees

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Plate Tectonics

Plate tectonics is an all-encompassing theory of geology that begins with the idea that the lithosphere of the earth is divided into many different plates. (See illustration at right.) Continental plates are of distinctively different composition than oceanic plates; they are made of less dense materials (granitic rocks as opposed to basaltic rocks) and, thus, "ride" higher than the oceanic plates. All of the earth's plates move constantly and, where the edges meet, one plate may slide past another (transform boundary) or one plate can be driven below the other (subduction). At other plate edges, upwelling of volcanic material pushes the plates apart (mid ocean ridges). Several hypotheses have been advanced to explain what drives the crustal plate movement, the most likely being that convection currents in the partially molten asthenosphere exert pressure on the rigid lithospheric plates, thus, causing them to move.

Chapter 7 contains details about geologic features in specific park areas.

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Geology of the Park: Volcanics

Hotspot

Most active volcanoes lie along tectonic plate boundaries at the spreading ridges in the oceans or at subduction zones. Some volcanoes occur where isolated plumes of heat and magma rise through the lithosphere; these plumes are called "hotspots." About 40 active hotspots are on the planet, most beneath the ocean, like the one that has formed the Hawaiian Island chain. Hotspots rarely occur under continents, but one such hotspot lies below Yellowstone.

The hotspot's plume of heat and magma is stationary, and the crustal plate moves across the hotspot. This movement of the crustal plate over the hotspot leaves a "track" of calderas that become younger nearer the park.

50–40 million years ago —Absaroka Volcanics—

16 million years ago, volcanics begin again in present day Nevada and Idaho

Yellowstone eruptions 2 million years ago to the present

Volcanoes in Yellowstone

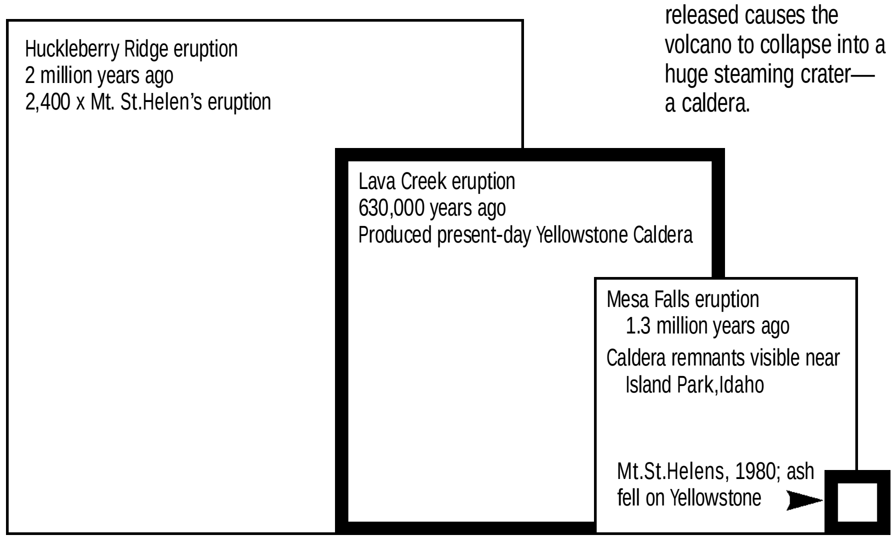
Volcanism in the Yellowstone area began about 50 million years ago during a period of extensive mountain building throughout the northern Rocky Mountains as subduction occurred along plate boundaries. The Absaroka Mountains, which lie along the eastern side of Yellowstone, were formed during this period, which ended about 40 million years ago.

About 16 million years ago, a series of volcanic eruptions began in what is now western Idaho and northern Nevada. A rare continental hotspot causes this activity. As the crustal plate has moved southwest over the hotspot, the volcanic activity has moved northeast.

About 2.1 million years ago, the track of this volcanic activity had neared present-day Yellowstone. The volcano was under the southwestern portion of Yellowstone, extending into the Island Park area of Idaho. The volume of material ejected during the volcanic explosion that occurred is difficult to imagine; it is estimated to be 2,400 times the size of the 1980 Mount St. Helens explosion; ash from this eruption has been found as far away as Missouri. The resulting collapse of this volcano is called the Huckleberry Ridge Caldera. While subsequent caldera explosions have destroyed much evidence of this event, geologists can still trace many areas of the caldera rim. The yellow rocks in the Golden Gate area of northern Yellowstone are Huckleberry Ridge tuff (welded ash).

Approximately 600,000 years later, a smaller volcanic eruption occurred on the western edge of the Huckleberry Ridge Caldera. The Henry's Fork Caldera, near Island Park, Idaho, is dated to 1.3 million years of age by the Mesa Falls tuff left from this explosion. After another 630,000 years of relative calm, the most recent volcanic event occurred, resulting in the Yellowstone Caldera, which was centered in Yellowstone. The caldera rim is still visible in many areas of the park (for example, Gibbon Falls, Lewis Falls, and Lake Butte) and is shown on page 18. The caldera is about 30 miles wide.

Yellowstone remains atop the hotspot and the pressure of the rising fluids and magma has created two bulges on the earth's surface. These bulges, called resurgent domes, lie within the caldera, one near LeHardys Rapids north of Yellowstone Lake and the other east of Old Faithful near Mallard Lake. Since the Yellowstone Caldera formed, lava has flowed onto the landscape numerous times. One explosive event occurred about 150,000 years ago that resulted in a smaller caldera that is today filled by the West Thumb of Yellowstone Lake.



About Volcanoes

A volcano is any place where the earth's crust opens and molten rock (magma) flows out and/or gases and rocks are thrown out in an eruption. In all volcanoes, magma rising from the mantle or lower part of the crust collects in the crust. This magma area is often called a reservoir, but it is actually an area of rocks with interstitial magma. Cracks in the crust allow the magma to reach the surface. (Once on the surface,magma is called lava.) Volcanoes that form over continental hotspots, such as in Yellowstone, tend to have lava laden with silica. Because silica-rich magma does not flow easily, these volcanoes tend to erupt violently.

As the heat and magma well up through the hotspot and into the magma "reservoir," pressure builds in the volcano. At Yellowstone and some other volcanoes, earth's crust fractures and cracks in a concentric or ring-fracture pattern. At some point these cracks reach the magma "reservoir," release the pressure, and the volcano explodes. The huge amount of material released causes the volcano to collapse into a huge steaming crater—a caldera.

The Hydrothermal System of Geyser Basins

In the mountains surrounding the Yellowstone Plateau, snow and rain slowly percolate through layers of porous rock riddled with cracks and fissures created by ring fractures and collapse of the caldera. Eventually this cold water meets the hot rocks associated with the shallow magma chamber beneath the surface. The water's temperature rises well above the boiling point and becomes superheated. This superheated water, however, remains in a liquid state due to the great pressure and weight pushing down on it from overlying rock and water. The result is something akin to a giant pressure cooker, with water temperatures in excess of 400°F.

The superheated water is less dense than the colder, heavier water sinking around it. This creates convection currents that allow the lighter, more buoyant, superheated water to begin its slow journey back toward the surface following the cracks, fissures, and weak areas through rhyolitic lava flows. As the hot water travels through the rock, the high temperatures dissolve some of the silica in the rhyolite, yielding a solution of silica within the water.

While in solution underground, some of this silica deposits as geyserite on the walls of the cracks and fissures, forming a nearly pressure-tight seal, locking in the hot water and creating a "plumbing system" that can withstand the great pressure needed to produce a geyser. At the surface, silica precipitates to form a rock called geyserite, or sinter, creating the massive geyser cones, the scalloped edges of hot springs, and the expansive, light colored, barren landscape of geyser basins.

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__Fountain geysers,__ such as Echinus in Norris Geyser Basin (above) generally shoot water out in various directions, most often from a pool. __Cone geysers,__ such as Riverside in Upper Geyser Basin (below) erupt in a narrow jet of water, usually from a cone.

__Geysers__ are hot springs that have constrictions in their plumbing, usually near the surface. These constrictions prevent water from circulating freely to the surface where heat would escape. The deepest circulating water can exceed the surface boiling point (199°F/93°C). The surrounding pressure also increases with depth, much as it does with depth in the ocean. Increased pressure exerted by the enormous weight of the overlying rock and water prevents the water from vaporizing. As the water rises, steam forms. Bubbling upward, steam expands as it nears the top of the water column until the bubbles are too large and numerous to pass freely through the tight spots. At a critical point, the confined bubbles actually lift the water above, causing the geyser to splash or overflow. This decreases pressure on the system, and violent boiling results. Tremendous amounts of steam force water out of the vent, and the eruption begins. Water is expelled faster than it can enter the geyser's plumbing system, and the heat and pressure gradually decrease. The eruption stops when the water reservoir is exhausted or when the gas bubbles diminish enough to be able to rise without ejecting the water.

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A Primer on Color in the Thermal Areas

The colors in hot springs and runoff channels result mostly from light refraction, suspended mineral particles, and large communities of microscopic organisms. These organisms are primitive lifeforms—algae, bacteria, and *Archaea*—that have inhabited the earth for almost four billion years. (*Archaea* were once considered a type of bacteria, but their DNA is completely different.) They grow in water too hot for most kinds of life on earth, even in boiling water. After water cools below 160ºF (70ºC), the organisms grow in thick, living layers of color in many different hues.

The chemistry of the thermal pools also influences the kinds and abundance of life. The boiling hot springs of Norris, some of which are more acidic than battery acid, sustain algae, bacteria, and *Archaea* far different from those living in the alkaline springs in the Old Faithful area.

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Hot Springs, *the most abundant thermal features in the park, have no constrictions in their plumbing.Superheated water cools as it reaches the surface and is replaced by hotter water from below. This circulation, called convection, prevents water from reaching the temperature needed to set off the chain reaction leading to an eruption.*

Mudpots *(below) are acidic hot springs with a limited water supply. Hydrogen sulfide, which rises from deep within the earth, is used by some microorganisms as an energy source. They help convert the smelly gas to sulfuric acid, which breaks down rock into clay. Various gases escape through the wet clay mud and cause it to bubble and plop. Mudpot activity varies with the seasons and the amount of precipitation.*

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Fumaroles *or steam vents, are the hottest hydrothermal features in the park. They have so little water that it all flashes into steam before reaching the surface. At places like Roaring Mountain (above), the result is a loud hissing of steam and gases.*

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Travertine terraces, *found at Mammoth Hot Springs (above), are formed from limestone, which is comprised of calcium carbonate. Hot water dissolves carbon dioxide gas into a solution of weak carbonic acid, which dissolves the calcium carbonate. At the surface, calcium carbonate deposits as travertine, the chalky white rock of the terraces. Due to the rapid rate of deposition—as much as 22 inches per year—these features change quickly and constantly.*

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Cyanobacteria grows in alkaline hot water. Its colors often follow a sequence from hottest to coolest: yellow, then green, red/orange, and brown. These different pigments gather solar energy or sunlight for photosynthesis. Cyanobacteria are one of the first organisms to evolve that used the energy of sunlight for life and produced free oxygen as a byproduct. They played a major role in creating an atmosphere that could support other lifeforms, including humans.

In acidic thermal areas, such as Norris and Mud Volcano, different organisms grow. For example, the neon green mats in the cooler features are often due to the alga *Cyanidium*. The purple color is often *Zygogonium*.

The acidic features of Norris and Mud Volcano are also colored by minerals, such as the gray color of sinter (a hydrated form of silica); the yellow color of sulfur; and the red, orange, and black color of iron and arsenic compounds. The color of the mudpots may be due to a single mineral or to a mixture, such as the red, muddy pools in which particles of silica or clay are coated with iron oxides. The shades of gray and black of the muds are often a result of iron sulfides.

In neutral areas, look for *Phormidium*, the organism causing orange “shag carpet” areas; *Synechococcus* and *Chloroflexus,* which form yellow and yellow-green color mats; and *Calothrix,* which appears as a brown organism in cool, neutral runoff channels around the park, for example, Castle Geyser (Upper Geyser Basin), Grand Prismatic Spring (Midway Geyser Basin), and Whirligig Geyser (Norris).

These bizarre life forms are still largely a mystery to scientists. For more about thermophiles and the issues surrounding them, see “Bioprospecting,” Chapter 6.

Earthquakes

Earthquakes occur along fault zones in the crust where the pressure from crustal plate movement builds to a significant level. The rock along these faults becomes so stressed that eventually it slips or breaks. Energy is then released as shock waves (seismic waves) that reverberate throughout the surrounding rock. Approximately 2,000 earthquakes occur each year in the Yellowstone area—most of which are not felt.

Different kinds of seismic waves (body waves) are released inside the earth during an earthquake. Primary waves ("P-waves") travel quickly back and forth horizontally, compressing and stretching the rock. Secondary waves ("S-waves") move up, down, and sideways through rock in a rolling motion. Once a seismic wave reaches the surface of the earth, it may be felt. Surface waves affect the landscape. The ground can roll (like a roller coaster), crack open, or be vertically and/or laterally displaced. Structures are susceptible to earthquake damage because the ground motion is usually horizontal.

Earthquakes in Yellowstone help to "maintain" hydrothermal features by keeping the "plumbing" system open. Without the periodic disturbance of relatively small earthquakes, the small fractures and conduits that supply hot water to geysers and springs might be sealed by deposition of siliceous sinter. Some earthquakes generate changes in Yellowstone's hydrothermal systems. The 1959 Hebgen Lake and 1983 Borah Peak earthquakes caused measurable changes in Old Faithful and many other thermal features.

Earthquakes are help us understand the subsurface geology around Yellowstone. The energy from earthquakes travels through the earth in much the same way that CAT scans are conducted on humans. We can "see" the subsurface and make images of the hotspot and the caldera by "reading" the energy that is emitted during earthquakes. An extensive geological monitoring system is in place to aid in that interpretation. Anyone can access real-time information about earthquakes in Yellowstone from a web site (www.seis.utah.edu/) maintained by the University of Utah Seismograph Stations.

Glaciers

Glaciers result when, for a period of years, more snow falls in an area than melts. Once the snow reaches a certain depth, it turns into ice and begins to move under the the force of gravity or the pressure of its own weight. During this movement, rocks are picked up and carried in the ice, and these rocks grind the earth's surface, eroding and carrying material away. Large U-shaped valleys, ridges of debris (moraines), and out-of-place boulders (erratics) are evidence of a glacier's passing.

Yellowstone and the much of North America have experienced numerous periods of glaciation during the last two million years. Succeeding periods of glaciation have destroyed most surface evidence of previous glacial periods, but scientists have found evidence of these glacial periods in sediment cores taken on land and in the ocean. Oceanic sediments contain the shell remains of one-celled animals, foraminifera. These shells are constructed using oxygen, and the ratio of oxygen isotopes in oceanic water at the time of shell formation remains a signature in the shells. One type of oxygen isotope (0^{18}) occurs in higher concentrations in colder water (i.e., when there is greater ice volume), and, thus, will be found in higher concentration in the foraminifera shells.

The last (and most studied) glacial period, the Pinedale, began about 80,000 years ago and was over by 14,000 years ago. At the peak of the Pinedale Glaciation 25,000 years ago, nearly all of today's Yellowstone National Park was covered by a huge ice sheet 4,000 feet thick (at a point above present-day Yellowstone Lake). Mount Washburn and Mt. Sheridan were both completely covered by ice. This ice field was not part of the continental ice sheet extending south from Canada during this time. The ice field occurred here, in part, because the hotspot beneath Yellowstone had pushed up the area to a higher elevation with colder temperatures and more precipitation than the surrounding land.

The Richter Scale

An earthquake's strength is measured by a scale of magnitude called the Richter scale, which is an absolute measure of the energy released during the earthquake. The scale is logarithmic; therefore, an increase of one unit on the scale represents a 10-fold increase in the energy released by a quake.

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The Porcupine Hills *formed when the hot water and steam from a thermal vent melted a hole in the glacier above it. Glacial meltwater deposited rocks, gravel, and sand being carried by the glacier into these holes in the ice. When the glacier melted or receded, the piles of debris—called kames — remained.Subsequent thermal activity cemented them into resistant hills. Other thermal kames exist at Mammoth Hot Springs.*

Previous to the Pinedale Glaciation, about 140,000 years ago, the Bull Lake Period glaciers covered the region. This glacial episode was larger in extent and depth than the Pinedale Glaciation. While it extended farther south of Yellowstone (into the Wind River Mountains) and west of Yellowstone (by about 12 miles) than the Pinedale Glaciation, no evidence of it is found to the north and east. This indicates that the subsequent Pinedale Glaciation destroyed surface evidence in these areas of Bull Lake Glaciation.

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The Beartooth Mountains northeast of Yellowstone are actually an uplifted plateau of Precambrian rock.

Mt.Everts,near Mammoth, exposes sedimentary rock which erode easily and often tumble into Gardner Canyon.

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Sedimentation & Erosion

Not all the rocks in Yellowstone are of "recent" volcanic origin. Precambrian igneous and metamorphic rock in the northeastern portion of the park are at least 2.7 billion years old. These rocks are very hard and erode slowly.

Sedimentary sandstones and shales, deposited by seas during the Paleozoic and Mesozoic eras (570 million to 67 million years ago) can be seen in the Gallatin Range and at Mount Everts. Sedimentary rocks in Yellowstone tend to erode more easily than the Precambrian rocks of the Beartooth Mountains.

One of the world's largest petrified forests exists in Yellowstone.

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Erosion can occur as a result of wind, water, glaciation, the freeze/thaw action of ice, or gravity. All rock formations will erode, some just do so more quickly. When erosion takes place, eventually sedimentation—the deposition of material—also occurs. Over time, sediments are buried by more sediments and the material hardens into rock. This rock is eventually exposed (through uplift or faulting), and the cycle repeats itself. Sedimentation and erosion are the "reshapers" and "refiners" of the landscape—and they are also the exposers of Yellowstone's past life as seen in fossils like the petrified trees, below left.

Fossils

Paleobotany

Nearly 150 species of fossil plants (exclusive of fossil pollen specimens) from Yellowstone have been described, including ferns, horsetail rushes, conifers and deciduous plants such as sycamores, walnuts, oaks, chestnuts, maples, and hickories. Sequoia is the dominant conifer. These are all plants of sub-tropical environments.

The first fossil plants from Yellowstone were collected by the early Hayden Survey parties. In his 1878 report of the Hayden Survey, Holmes made the first reference to Yellowstone's fossil forests. The report identified the petrified trees located on the north slope of Amethyst Mountain opposite the mouth of Soda Butte Creek, about eight miles southeast of Junction Butte.

Around 1900, F.H. Knowlton identified 147 species of fossil plants from Yellowstone, 81 of them new to science. He believed the most remarkable fossil forest was on the northwest end of Specimen Ridge, where it covers several acres on a steep hillside (below left). Most of the trees project above the surface, including hundreds of trunks from 1 to 8 feet in diameter and from 1 to 20 feet high, with the tallest more than 40 feet. Fossilized bark is also preserved at this location. This petrified forest—the largest in the world—consists of more than two dozen forests, each buried by activity during the Absaroka Volcanic period.

Most petrified wood and other plant fossils come from Eocene deposits, which occur in many northern portions of the park, including the Gallatin Range, Specimen Creek, Tower, Crescent Hill, Elk Creek, Specimen Ridge, Bison Peak, Barronette Peak, Abiathar Peak, Mount Norris, Cache Creek, and Miller Creek. Petrified wood is also found along streams in areas east of

Yellowstone Lake. The most accessible fossil forest is west of Tower Fall.

Two new Late Cretaceous fossil plant locations were discovered on Mount Everts in 1997. Preliminary fieldwork yielded a variety of deciduous leaves, including willow-like leaf and a fern. A single willow-like leaf was found in association with the plesiosaur remains excavated in 1997. In 1994 fossil plants were discovered in Yellowstone during the East Entrance road construction project, which uncovered five areas containing fossil sycamore leaves.

Fossil Invertebrates

Fossil invertebrates are abundant in Paleozoic rocks, especially the limestones associated with the Madison Group in the northern and south-central parts of the park. They include corals, bryozoans, brachiopods, trilobites, gastropods, crinoids, and Pleistocene insects. Trace fossils, such as channeling and burrowing of worms, are found in some petrified tree bark.

Fossil Vertebrates

Fossil remains of vertebrates are rare, but perhaps only because of insufficient field research. A recent one-day survey led by paleontologist Jack Horner, of the Museum of the Rockies, Bozeman, Montana, resulted in the discovery of a piece of turtle shell, the skeleton of a Cretaceous plesiosaur, and a dinosaur eggshell fragment. The only other dinosaur remains known from the park are a few bone fragments. Other vertebrate fossils found in Yellowstone include:

- Fish: A crushing tooth plate; phosphatized fish bones; fish scales; fish teeth
- A possible Pleistocene horse, *Equus nebraskensis,* was reported by Lewis in 1939
- A possible *Bison occidentalis* skull, which was discovered in northeast Wyoming and dated to 6470 B.P. Other reports of bison from the park include McCartneys Cave and Stevenson Island
- Holocene subfossil mammals recovered from Lamar Cave

Yellowstone As a Laboratory

Yellowstone is a unique outdoor laboratory for scientists who conduct geophysical research. Many of these scientific studies have ramifications far beyond Yellowstone National Park. Current research examples:

- *Earthquake monitoring stations detect the numerous daily tremors occurring in the Yellowstone region, and the patterns are studied to develop an understanding of the geodynamics of Yellowstone's hotspot.*
- *Studies on the location of previously unmapped geologic structures should help us understand what controls subsurface fluid flow and recharge in the geothermal systems.*
- *Baseline geochemical studies help to distinguish between human and natural influences on the underground water network in the region.*
- *Underwater studies in Yellowstone Lake have identified hydrothermal vents where organisms that survive on sulfur emissions and that resemble life found under the ocean near similar hydrothermal vents have been found; comparison studies continue. (See Chapter 7.)*
- *The deposition of sinter around thermal springs is being studied to understand how early life developed on earth and to look for these clues on other planets, particularly Mars.*
- *Thermophiles, microorganisms that can live in extreme environments, are being collected from the park's thermal features,identified, and their heat-resistant enzymes are being studied. Some already are being used in a variety of medical and forensic processes.*

All scientists in Yellowstone work under special permits and are closely supervised by National Park Service staff.

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Geoecosystem

Yellowstone National Park forms the core of the Greater Yellowstone Ecosystem—one of the largest intact temperate zone ecosystems on the earth today. This 28,000-square-mile region of mainly federal lands preserves and nurtures a variety of wildlife species and the natural processes that sustain them. All the wildlife species known to be in the region when European Americans arrived exist here today.

Much of Yellowstone's landscape and its biological components are the consequence of geological forces and processes. Uplift generated by hotspot volcanism has created the high-altitude Yellowstone Plateau. Moreover, the track of the hotspot that extends into Idaho forms a large-scale avenue for westerly storm systems to travel eastward up onto the plateau, carrying and dropping large amounts of winter precipitation.

The distribution of rocks and sediments within the park also imposes important controls on the distributions and movements of flora and fauna. The volcanic rhyolites and tuffs of the Yellowstone Caldera are rocks rich in silica, aluminum, and potassium. Soils formed from these rocks are nutrient deficient. Thus, most areas of the park that are underlain by rhyolites and tuffs are characterized by extensive, monotypic stands of lodgepole pine. Lodgepoles have shallow root systems and can inhabit these nutrient-poor regions. In contrast, andesitic volcanic rocks underlie the Absaroka Mountains. Andesites are rich in calcium, magnesium, and iron, elements that result in much more fertile soils. You can see the result when you drive over Dunraven Pass or other areas of the park with Absaroka rocks: They have a richer flora that includes mixed forests of Englemann spruce, whitebark pine, and sub-alpine fir, interspersed with meadows. Lake sediments such as those underlying Hayden Valley, that were deposited during glacial periods, have a greater water-holding capacity and can support rich meadow communities. The little patches of lodgepole pines visible in Hayden Valley represent small areas of rhyolite rock outcrops. Given this control of flora distribution by rock type, it is easy to understand how geology controls wildlife distributions and movement.

Whitebark pine is an important food source for grizzly bears during the fall. As such, the bears will migrate to andesitic volcanic terranes during pine nut harvest. Many of the ungulates (hoofed animals such as bison and elk) take full advantage of the rich Hayden Valley meadows for foraging. And the many thermal areas of the park provide a haven for animals during the winter. Geological characteristics truly form the foundation of an ecosystem. Those relationships are magnificently displayed in Yellowstone National Park. The interplay between volcanic and hydrothermal processes, rock types, and the distribution of flora and fauna are intricate and unique.

Many other unique lifeforms are protected here, too. Various species of micro-organisms are the living representatives of the primitive lifeforms now recognized as the beginnings of life on this planet. The original atmosphere on earth was anoxic (without oxygen), and cyanobacteria were the first organisms capable of photosynthesis (the process by which plants use sunlight to convert carbon dioxide to oxygen and other byproducts). Consequently, these organisms began to create an atmosphere on earth that would eventually support plants and animals.

A visit to Yellowstone today can be viewed as a trip in a time machine where you can discover the beginnings of geologic and biologic earth.

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Videos

Yellowstone: A Symphony of Fire and Ice (available summer 2001)

Yellowstone Revealed

The Complete Yellowstone

Yellowstone: Imprints of Time

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In the park's early years visitors often used thermal features as "wishing wells"—and this continues today. Coins,rocks, trash, logs or stumps, and other paraphernalia are found in the narrow vents of geysers and hot springs, such as Morning Glory Pool,above. Features have been plugged up, and little can be done to repair them. People also damage thermal features when they leave walkways, climb on formations,or break off pieces for souvenirs.

Features can also be affected by nearby ground-disturbing activities.Construction and maintenance activities in the park must be carefully designed and monitored. No one knows if geothermal drilling outside the park would harm the features in Yellowstone.